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Under Contract F23613-77-D-0011, AFCC SETA Task 81-3, Computer Sciences Corporation (CSC) has performed an analysis of all available Air Force Automated Message Processing Exchange (AFAMPE) performance characteristics documentation of the Scott, Sembach, and Ramstein Air Force Bases. The results of this analysis identify performance and throughput criteria for the AFAMPE. These criteria will be used to establish the tests that are applied to AFAMPE configuration as the "most severe load" conditions. Section 2 of this document addresses the performance analysis, and Section 3 addresses the applied testing -

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methodology.

PERFORMANCE ANALYSIS AND TEST CRITERIA
FOR
TASK 81-3
AIR FORCE AUTOMATED MESSAGE PROCESSING EXCHANGE (AFAMPE) REQUIREMENTS AND SYSTEM ANALYSIS

FINAL REPORT

Prepared for

U.S. AIR FORCE COMMUNICATIONS COMMAND
SCOTT AIR FORCE BASE, ILLINOIS

Under

CONTRACT F23613-77-D-0011

26 FEBRUARY 1982

COMPUTER SCIENCES CORPORATION

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Major Offices and Facilities Throughout the World

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Under Contract F23613-77-D-0011 AFCC SETA Task 81-3, Computer Sciences Corporation (CSC) has performed an analysis of all available Air Force Automated Message Processing Exchange (AFAMPE) performance characteristics documentation of the Scott, Sembach, and Ramstein Air Force Bases. The results of this analysis identify performance and throughput criteria for the AFAMPE. These criteria will be used to establish the tests that are applied to AFAMPE configurations as the "most severe load" conditions. Section 2 of this document addresses the performance analysis, and Section 3 addresses the applied testing methodology.

SECTION 2 - PERFORMANCE ANALYSIS

2.1 GENERAL

To assure the total success of near-term AFAMPE installations in extraordinarily diverse and dynamic user environments, the Phase IV Project Management Office (PMO) tasked CSC to analyze documents and determine performance criteria for the most severe load conditions. In contrast to functional criteria that identify the standard for what the AFAMPE must do, the performance criteria identifies the standard of AFAMPE execution.

Various documents (referenced in Paragraph 2.1 of the Task Statement of Work) relating to system, message, and line block loading were provided to CSC as inputs to the task. From this information, initial criteria have now been established against which to measure the AFAMPE performance. The remainder of this section describes how these criteria were developed.

2.2 DERIVATION OF PERFORMANCE CHARACTERISTICS

To support the analysis and determination of performance criteria, the data supplied by the Phase IV PMO was ordered in a matrix of columns and rows. The rows represent the local topology or connectivity of the AFAMPE. The columns contain progressive extrapolations of the topology workload from Raw Data through Raw Data Plus 'J' Factor, Raw Data Plus 'J' Factor Plus Growth, and Line Capacity. In some cases, the original data was adjusted to reflect accurately the line throughput capabilities of a real-time communications system. These adjustments are identified as notes to Tables 2-1 through 2-4 where required. In all cases, a 30-day month was used as the baseline to derive average hourly line block load.

2.2.1 Raw Data

The Raw Data column reflects present or projected line blocks per hour traffic loads. The Average Hour subcolumn for Raw Data was computed by dividing the average monthly line blocks for a given circuit by 720 (monthly hours available). If the monthly load was not provided, figures from similar circuits were substituted. In the case of some Sembach circuits, hourly averages were computed by assuming (after analyzing other AFAMPE circuits) a circuit rate use of 25 percent of effective line capacity.

Table 2-1. Scott AFAMPE (1 of 3)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
4800 Baud														
ASC Circuits														
AUTODIN #1	4195	4738	7551	8528	5243	5922	9437	10659	6973	7876	12551	14176	20520	20520
AUTODIN #2	4195	4738	7551	8528	5243	5922	9437	10659	6973	7876	12551	14176	20520	20520
AUTODIN #3	4195	4738	7551	8528	5243	5922	9437	10659	6973	7876	12551	14176	20520	20520
ASC TOTAL	12585	14214	22653	25584	15729	17766	28311	31977	20919	23628	37653	42528	61560	61560
AFAMPE Trubutaries														
4800 Baud														
DECCO	598	722	1076	1299	747	902	1344	1623	993	1199	1787	2158	20520	20520
WWMCCS	5543	5149	9977	9268	6928	6436	12470	11584	9214	8559	16585	15406	20520	20520
MACIMS PAX RESV	2771	2574	4987	4633	3463	3217	6233	5790	4605	4278	8289	7700	20520	20520
MACIMS CARGO	2771	2574	4987	4633	3463	3217	6233	5790	4605	4278	8289	7700	20520	20520
2199CS	598	722	1076	1299	747	902	1344	1623	993	1199	1787	2158	20520	20520
AFCC/MP 300 LPM Pntr	---	25	---	45	---	31	---	55	---	41	---	73	---	17100
MAC/CP 300 LPM Pntr	---	736	---	1324	---	920	---	1656	---	1223	---	2201	---	17100
Subtotal	12281	12502	22103	22501	15348	15625	27624	28121	20410	20777	36737	37396	102600	136800
2400 Baud														
MAC/CP KVDT #1	2		3		2		3		2		3		225	
MAC/CP KVDT #2	2		3		2		3		2		3		225	
AFCC/MP KVDT #1	15		27		18		32		23		41		225	
AFCC/MP KVDT #2	15		27		18		32		23		41		225	
AFCC/CP 150 LPM Pntr		159		286		198		356		263		473		8550
AFCC/CP KVDT	3		5		3		5		3		5		225	
ARRS/CP 150 LPM Pntr		63		113		78		140		103		185		8550
ARRS/CP KVDT #1	3		5		3		5		3		5		225	
ARRS/CP KVDT #2	3		5		3		5		3		5		225	
375/CP 150 LPM Pntr		10		18		12		21		15		27		8550
375/CP KVDT	3		5		3		5		3		5		255	
Subtotal	46	232	80	417	57	288	90	517	62	381	108	685	1800	25650
1200 Baud														
US Coast Guard	3	159	5	286	3	198	5	356	3	263	5	473	5130	5130
Subtotal	3	159	5	286	3	198	5	356	3	263	5	473	5130	5130
75 Baud														
Granite City		11		19		13		23		17		30	320	320
US Coast Guard	57	63	102	113	71	78	127	140	94	103	169	185	320	320
Subtotal	57	74	102	132	71	91	127	163	[illegible]	120	[illegible]	215	640	640

Table 2-1. Scott AFAMPE (2 of 3)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
Future Requirements														
4800 Baud	2456	1786	4420	3214	3070	2232	5526	4017	4083	2968	7349	5342	20520	20520
2400 Baud KVDT #1	5		9		6		10		7		12		225	
KVDT #2	5		9		6		10		7		12		225	
KVDT #3	5		9		6		10		7		12		225	
Printer #1		77		138		96		172		127		228		8550
Printer #2		77		138		96		172		127		228		8550
Printer #3		77		138		96		172		127		228		8550
75-1200 Baud #1	30	77	54	138	37	96	66	172	49	127	88	228	5130	5130
#2	30	77	54	138	37	96	66	172	49	127	88	228	5130	5130
#3	30	77	54	138	37	96	66	172	49	127	88	228	5130	5130
TOTAL Future Rqmts	2561	2248	4609	4042	3199	2808	5754	5049	4251	3730	7649	6710	36585	61560
Tributary TOTALS	12387	13121	22290	23336	15479	16202	27846	29157	20569	21541	37019	38769	110170	168220
Tributary + Future Requirements TOTAL	14948	15215	26899	27378	18678	19010	33600	34206	24820	25271	44668	45479	146755	229780
ASC + Tributary TOTAL	24972	27181	44943	48920	31208	33968	56157	61134	41488	45169	74672	81297	171730	229780
Tributary + Future Requirements + ASC	27533	29429	49552	57962	34407	36776	61911	66183	45739	48899	82321	88007	208315	274240

Table 2-1. Scott AFAMPE (3 of 3)

1. The "RAW AVERAGE HOUR" was derived by dividing the provided monthly statistics by 720 (monthly hours). This quotient was then derived by 3 (AUTODIN circuits).

2. Where tributary data was provided we divided the monthly figures by 720 (monthly hours). Where data was not provided, we substituted figures from like circuits.

3. The "AVERAGE HOUR" for Future Requirement Circuits were derived by computing an average for like circuits.

4. The KVDT statistics for "LINE CAPACITY" (SEND) have been fixed at 225 line blocks per hour. Rationale:
   60 WPM x 5 (characters per word) = 300 CPM
   300 CPM x 60 (minutes per hour) = 18,000 character per hour
   18000 divided by 80 (characters per line block) = 225 line blocks per hour
   The statistics for "LINE CAPACITY" (REC) (150 LPM printers) is fixed at 8550 or line capacity whichever is smaller.
   150 LPM x 60 (minutes per hour) = 9,000
   95% (effective line capability) x 9000 = 8,550 Line Blocks per Hour
   300 LPM Printer = 17,100 or line capacity whichever is smaller
   (8550 x 2 = 17,100)

5. All statistics are listed in line blocks per hour as truncated integers.

Table 2-2. Sembach AFAMPE (1 of 3)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
1200 Baud														
ASC Circuit #1	1808	3300	3254	5940	2260	4125	4068	7425	3005	5486	5409	9874	5130	5130
ASC Circuit #2	1808	3300	3254	5940	2260	4125	4068	7425	3005	5486	5409	9874	5130	5130
ASC TOTALS	3616	6600	6508	11880	4520	8250	8136	14850	6010	10972	10818	19748	10260	10260
AFAMPE Tributaries														
2400 Baud														
Sembach C^2 300 LPM Pntr		455		819		568		1022		755		1359		10260
Sembach C^2 KVDT	49		88		61		109		81		145		225	
Subtotal	49	455	88	819	61	568	109	1022	81	755	145	1359	225	10260
1200 Baud														
RAF Fairford	1282	1282	2307	2307	1602	1602	2883	2883	2130	2130	3834	3834	5130	5130
Subtotal	1282	1282	2307	2307	1602	1602	2883	2883	2130	2130	3834	3834	5130	5130
300 Baud-Mode I														
Bitburg-GE	91	168	153	302	113	210	203	378	150	279	270	502	1282	1282
Hahn, GE	82	197	147	354	102	246	183	442	135	327	243	588	1282	1282
Lakeheath, UK	60	168	108	302	75	210	135	378	99	279	178	502	1282	1282
Mildenhall, UK	113	387	203	696	141	483	253	869	187	642	336	1155	1282	1282
Ramstein, GE	90	221	162	397	112	276	201	496	148	367	266	660	1282	1282
Spangdahlem, GE	77	180	138	324	96	225	172	405	127	299	228	538	1282	1282
Zweibrucken, GE	43	36	77	64	53	45	95	81	70	59	126	106	1282	1282
Lah., AB	24	58	43	104	30	72	54	129	39	95	70	171	1282	1282
Sellingen, GE	190	849	342	1528	237	1061	426	1909	315	1411	567	2539	1282	1282
Subtotal	770	2264	1383	4071	959	2828	1722	5087	1270	3758	2284	6761	11538	11538
75 Baud-Mode II														
Pruen CRP	80	80	144	144	100	100	180	180	133	133	239	239	320	320
601 ASOC	80	80	144	144	100	100	180	180	133	133	239	239	320	320
ABCCC	80	80	144	144	100	100	180	180	133	133	239	239	320	320
602 ASOC	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Mehlingen Crp	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Turkheim Crp	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Subtotal	480	480	864	864	600	600	1080	1080	798	798	1434	1434	1920	1920

Table 2-2. Sembach AFAMPE (2 of 3)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
50 Baud-Mode II														
KALKAR ATOC	53	53	95	95	66	66	118	118	87	87	156	156	213	213
TARE #1	53	53	95	95	66	66	118	118	87	87	156	156	213	213
TARE #2	53	53	95	95	66	66	118	118	87	87	156	156	213	213
HQ CENTAG	53	53	95	95	66	66	118	118	87	87	156	156	213	213
I (FR) ASOC	53	53	95	95	66	66	118	118	87	87	156	156	213	213
II (FR) ASOC	53	53	95	95	66	66	118	118	87	87	156	156	213	213
III (FR) ASOC	53	53	95	95	66	66	118	118	87	87	156	156	213	213
HQ 4 ATAF	53	53	95	95	66	66	118	118	87	87	156	156	213	213
SOC III	53	53	95	95	66	66	118	118	87	87	156	156	213	213
50 Baud-Mode IV														
MESSTETTEN ATOC	53	53	95	95	66	66	118	118	87	87	156	156	213	213
MAASTRICHT ATOC	53	53	95	95	66	66	118	118	87	87	156	156	213	213
HQ FATAL	53	53	95	95	66	66	118	118	87	87	156	156	213	213
II (GE) ASOC	53	53	95	95	66	66	118	118	87	87	156	156	213	213
Subtotal	689	689	1235	1235	858	858	1534	1534	1131	1131	2028	2028	2769	2769
Future Requirements														
2400 Baud KVDT #1	49		88		61		109		81		145		255	
#2	49		88		61		109		81		145		255	
Printer #1		455		819		568		1022		755		1359		10260
#2	—	455	—	819	—	568	—	1022	—	755	—	1359	—	10260
Subtotal	98	910	176	1638	122	1136	218	2044	162	1510	250	2718	510	20520
50-1200 Baud														
#1	110	159	198	286	137	198	246	356	182	263	327	473	736	736
#2	110	159	198	286	137	198	246	356	182	263	327	473	736	736
#3	110	159	198	286	137	198	246	356	182	263	327	473	736	736
#4	110	159	198	286	137	198	246	356	182	263	327	473	736	736
#5	110	159	198	286	137	198	246	356	182	263	327	473	736	736
#6	110	159	198	286	137	198	246	356	182	263	327	473	736	736
#7	110	159	198	286	137	198	246	356	182	263	327	473	736	736
#8	110	159	198	286	137	198	246	356	182	263	327	473	736	736
#9	110	159	198	286	137	198	246	356	182	263	327	473	736	736
Subtotal	990	1431	1782	2574	1233	1782	2214	3204	1638	2367	2943	4257	6628	6628
Future Requirements TOTAL	1088	2341	1958	4212	1355	2918	2432	5248	1800	3877	3233	6975	7138	27148
Tributary TOTALS	3270	5170	5877	9296	4080	6456	7328	11606	5410	8572	9725	15416	21582	31617
Tributary & Future TOTAL	4358	7511	7835	13508	5435	9374	9760	16854	7210	12449	12958	22391	28720	58765
ASC Plus Tributary TOTAL	6886	11770	12385	21176	8600	14706	15464	26456	11420	19544	20543	35174	31842	41877
ASC + Tributary + Future Requirements TOTAL	7974	14111	14343	[illegible]	[illegible]	[illegible]	17696	31704	13220	23421	23776	42149	38980	69025

Table 2-2. Sembach AFAMPE (3 of 3)

1. The ASC "RAW AVERAGE HOUR" was derived by adding the "RAW AVERAGE HOUR" of the SEMBACH Tributaries to the "RAW AVERAGE HOUR" of SEMBACH TCC (listed on Ramstein statistics). This total was divided by 2 (2 AUTODIN circuits).

2. Where tributary data was not provided, we substituted figures which are equal to 25 percent of the effective line capacity (95% line speed). i.e., for a 1200 baud circuit, we multiplied maximum line capacity (5400 LBKS/Hour) times 95% times 25%.

3. Tributary data that was given in messages per month were changed to line blocks per month by using the formula "ONE MESSAGE EQUALS 33 LINE BLOCKS." This formula was recommended by phase IV PMO.

4. "FUTURE REQUIREMENT" circuits were derived by applying the given growth formula and the "RAW AVERAGE HOUR" was derived by finding an average of all 50 through 1200 baud circuits.

5. All statistics are listed in line blocks per hour as truncated integers.

Table 2-3. Ramstein AFAMPE (1 of 4)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
2400 Baud														
ASC Circuits														
AUTODIN #1	1400	4736	2520	8524	1750	5920	3150	10656	2327	7873	4183	14171	10260	10260
AUTODIN #2	1400	4736	2520	8524	1750	5920	3150	10656	2327	7873	4183	14171	10260	10260
AUTODIN #3	1400	4736	2520	8524	1750	5920	3150	10656	2327	7873	4183	14171	10260	10260
ASC TOTALS	4200	14208	7560	25572	5250	17760	9450	31968	6981	23619	12564	42513	30780	30780
AFAMPE Tributaries														
4800 Baud														
Zweibrucken DPI	833	3472	1499	6249	1041	4340	1873	7812	1384	5772	2491	10389	20520	20520
Subtotal	833	3472	1499	6249	1041	4340	1873	7812	1384	5772	2491	10389	20520	20520
1200 Baud-SRT Remotes														
Kaiserslautern TCC	1153	1212	2075	2181	1441	1515	2593	2727	1916	2014	3448	3625	5130	5130
Pirmasens	312	928	561	1670	390	1160	702	2088	518	1542	932	2775	5130	5130
Maasweiler	55	158	99	284	68	197	122	354	90	262	162	471	5130	5130
Miesau	29	227	52	408	36	283	64	509	47	376	84	676	5130	5130
Baumholder	80	320	144	576	100	400	180	720	133	532	239	957	5130	5130
Zweibrucken TCC	134	587	241	1056	167	733	300	1319	222	974	399	1753	5130	5130
Sembach TCC	347	1430	624	2574	433	1787	779	3216	575	2376	1035	4276	5130	5130
Subtotal	2110	4862	3796	8749	2635	6075	4740	10933	3501	8076	6299	14533	35910	35910
600 Baud														
Sembach BAS/SUP	3	10	5	18	3	12	5	21	3	15	5	27	2565	2565
Zweibrucken BAS/SUP	2	9	3	16	2	11	3	19	2	14	3	25	2565	2565
Subtotal	5	19	8	34	5	23	8	40	5	29	8	52	5130	5130
75 Baud														
Friegefeld	2	72	3	129	2	90	3	162	2	119	3	214	320	320
Fischback	3	20	5	36	3	25	5	45	3	33	5	59	320	320
Subtotal	5	92	8	165	5	115	8	207	5	152	8	273	640	640

Table 2-3. Ramstein AFAMPE (2 of 4)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
1200 Baud														
KVDT and Printers														
USAFE/DO 300 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
USAFE/LGS 300 LMP Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
USAFE/IN 300 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
USAFE/DP 300 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
USAFE/DE 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
USAFE/CS 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
USAFE/XP 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
OSC-ALCC 300 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
OSC-ALCC KVDT	39	---	70	---	48	---	86	---	63	---	113	---	225	---
OSC-EAC 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
OSC-EAC KVDT	39	---	70	---	48	---	86	---	63	---	113	---	225	---
OSC-Admin 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
OSC-Admin KVDT	39	---	70	---	48	---	86	---	63	---	113	---	225	---
OSC-B/S KVDT	39	---	70	---	48	---	86	---	63	---	113	---	225	---
OSC-LRC 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
OSC-LRC KVDT	39	---	70	---	48	---	86	---	63	---	113	---	225	---
Kapaun 300 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
Kapaun KVDT	5	---	9	---	6	---	10	---	7	---	12	---	225	---
Kapaun OCR	5	---	9	---	6	---	10	---	7	---	12	---	225	---
322 ALD 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
322 ALD KVDT	39	---	70	---	48	---	86	---	63	---	113	---	225	---
86 CSG/DP 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
7 AD 150 LPM Printer	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
86 TFW/DO&IN 150 LPM Pntr	---	177	---	318	---	221	---	397	---	293	---	527	---	5130
608 Mass KVDT	39	---	70	---	48	---	86	---	63	---	113	---	225	---
86 TFW/COC 150 LPM Pntr#1	---	4	---	7	---	5	---	9	---	7	---	13	---	5130
86 TFW/COC 150 LPM Pntr#2	---	4	---	7	---	5	---	9	---	7	---	13	---	5130
86 TFW/COC KLDT	14	---	25	---	18	---	32	---	24	---	43	---	225	---
86 TFW/PTR/P	2	2	3	3	2	2	3	3	2	2	3	3	---	---
Subtotal	299	2842	536	5105	368	3548	657	6373	481	4704	861	8461	7155	12340
Future Requirements														
4800 Baud	633	3472	1499	6249	1041	4340	1873	7812	1384	5722	2491	9489	20520	20520
75-1200 Baud														
SRT #1	301	694	541	1249	376	867	676	1560	500	1153	900	2075	5130	5130
SRT #2	301	694	541	1249	376	867	676	1560	500	1153	900	2075	5130	5130
600 Baud #3	2	9	3	16	2	11	3	19	2	14	3	25	2565	2565
75 Baud #4	2	46	3	82	2	57	3	102	2	75	3	135	641	641
KVDT #5	27		48		33		59		43		77		225	
KVDT #6	27		48		33		59		43		77		225	
KVDT #7	27		48		33		59		43		77		225	

Table 2-3. Ramstein AFAMPE (3 of 4)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
KVDT #8	27		48		33		59		43		77		225	
KVDT #9	27		48		33		59		43		77		225	
KVDT #10	27		48		33		59		43		77		225	
KVDT #11	27		48		33		59		43		77		225	
KVDT #12	27		48		33		59		43		77		225	
KVDT #13	27		48		33		59		43		77		225	
KVDT #14	27		48		33		59		43		77		225	
KVDT #15	27		48		33		59		43		77		225	
KVDT #16	27		48		33		59		43		77		225	
KVDT #17	27		48		33		59		43		77		225	
Printer #1		149		268		186		334		247		444		5130
Printer #2		149		268		186		334		247		444		5130
Printer #3		149		268		186		334		247		444		5130
Printer #4		149		268		186		334		247		444		5130
Printer #5		149		268		186		334		247		444		5130
Printer #6		149		268		186		334		247		444		5130
Printer #7		149		268		186		334		247		444		5130
Printer #8		149		268		186		334		247		444		5130
Subtotal	957	2635	1712	4740	1185	3250	2125	5913	1563	4371	2807	7862	16391	54506
Future Requirements TOTAL	1790	6107	3211	10983	2226	7630	3998	13725	2947	10143	5298	18257	36911	75026
Tributary TOTAL	3252	11287	5847	20302	4054	14101	7286	25365	5376	18733	9667	33708	69355	154540
Tributary + Future Requirements TOTAL	5042	17394	9053	31291	6280	21731	11284	39090	8323	28876	14965	51965	106266	229566
ASC + Tributary TOTAL	7452	25495	13407	45874	9304	31863	16736	57333	12357	42352	22231	76271	100135	185320
ASC + Tributary + Future Requirements TOTAL	9242	31602	16618	56863	11530	39491	20734	71058	15304	52495	27529	94478	137046	260346

Table 2-3. Ramstein AFAMPE (4 of 4)

1. The ASC "RAW AVERAGE HOUR" was derived by dividing the provided data by 720 (monthly hours). To this quotient we added the "RAW AVERAGE HOUR" for the 4800 baud, 1200 baud SRT, 600 baud, and 75 baud tributaries. We divided the aggragate by 3 (AUTODIN circuits).

2. AFAMPE tributary "AVERAGE HOUR" was derived by dividing the provided monthly statistics by 720 (monthly hours).

3. We multiplied the provided totals for the ASC times 40% to compute the AVERAGE HOUR for the KVDTs and printers. Next we divided the result by 13 (original 13 staff remotes as listed on draft report of A001).

4. The "AVERAGE HOUR" for Future Requirement Circuits was derived by computing the average for like circuits. In addition to the normal circuit growth we made allowance for future requirements as identified in PGA letter dated 3 February 1982.

5. All statistics are listed in line blocks per hour as truncated integers.

Table 2-4. Most Severe (1 of 3)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
4800 Baud														
ASC Circuits														
AUTODIN #1	4195	4738	7551	8528	5243	5922	9437	10659	6973	7876	12551	14176	20520	20520
AUTODIN #2	4195	4738	7551	8528	5243	5922	9437	10659	6973	7876	12551	14176	20520	20520
AUTODIN #3	4195	4738	7551	8528	5243	5922	9437	10659	6973	7876	12551	14176	20520	20520
ASC TOTAL	12585	14214	22653	25584	15729	17766	28311	31977	20919	23628	37653	42528	61560	61560
4800 Baud Tribs														
#1	598	722	1076	1299	747	902	1344	1623	993	1199	1787	2158	20520	20520
#2	5543	5149	9977	9268	6928	6436	12470	11584	9214	8559	16585	15406	20520	20520
#3	2771	2574	4987	4633	3463	3217	6233	5790	4605	4278	8289	7700	20520	20520
#4	2771	2574	4987	4633	3463	3217	6233	5790	4605	4278	8289	7700	20520	20520
#5	598	722	1076	1299	747	902	1344	1623	993	1199	1787	2158	20520	20520
Receive Only #6		25		45		31		55		41		73		20520
Receive Only #7		736		1324		920		1656		1223		2201		20520
Subtotal	12281	12502	22103	22501	15348	15625	27624	28121	20410	20777	36737	37396	102600	143640
2400 Baud														
KVDT #1	5		9		6		10		7		12		225	
KVDT #2	5		9		6		10		7		12		225	
KVDT #3	5		9		6		10		7		12		225	
KVDT #4	5		9		6		10		7		12		225	
KVDT #5	5		9		6		10		7		12		225	
KVDT #6	5		9		6		10		7		12		225	
KVDT #7	5		9		6		10		7		12		225	
KVDT #8	5		9		6		10		7		12		225	
Printer #1		77		138		96		172		127		228		8550
Printer #2		77		138		96		172		127		228		8550
Printer #3		77		138		96		172		127		228		8550
Subtotal	40	231	72	414	48	288	80	516	56	381	96	684	1800	25650
1200 Baud SRTs														
Tributary #1	1153	1212	2075	2181	1441	1515	2593	2727	1916	2014	3448	3625	5130	5130
#2	312	928	561	1670	390	1160	702	2088	518	1542	932	2775	5130	5130
#3	55	158	99	284	68	197	122	354	90	262	162	471	5130	5130
#4	29	227	52	408	36	283	64	509	47	376	8[illegible]	676	5130	5130
#5	80	320	144	576	100	400	180	720	133	532	239	957	5130	5130
#6	134	587	241	1056	167	733	300	1319	222	974	399	1753	5130	5130
#7	347	1430	624	2574	434	1787	779	3216	575	2376	10[illegible]	4276	5130	5130
Subtotal	2110	4862	3796	8749	2635	6075	4740	10933	3501	8076	6299	14533	35910	35910

Table 2-4. Most Severe (2 of 3)

	RAW DATA				RAW DATA + 'J' FACTOR				RAW DATA + 'J' FACTOR + GROWTH				LINE CAPACITY	
	AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		AVERAGE HOUR		BUSY HOUR		10 MIN PEAK	
	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC	SEND	REC
1200 Baud														
KVDT #1	29		52		36		64		47		84		225	
KVDT #2	29		52		36		64		47		84		225	
KVDT #3	29		52		36		64		47		84		225	
KVDT #4	29		52		36		64		47		84		225	
KVDT #5	29		52		36		64		47		84		225	
KVDT #6	29		52		36		64		47		84		225	
KVDT #7	29		52		36		64		47		84		225	
KVDT #8	29		52		36		64		47		84		225	
KVDT #9	29		52		36		64		47		84		225	
JCR	29		52		36		64		47		84		225	
PTR/P	2	2	3	3	2	2	3	3	2	2	3	3		
Printer #1		157		282		196		352		260		468		5130
Printer #2		157		282		196		352		260		468		5130
Printer #3		157		282		196		352		260		468		5130
Printer #4		157		282		196		352		260		468		5130
Printer #5		157		282		196		352		260		468		5130
Printer #6		157		282		196		352		260		468		5130
Printer #7		157		282		196		352		260		468		5130
Printer #8		157		282		196		352		260		468		5130
Printer #9		157		282		196		352		260		468		5130
Printer #10		157		282		196		352		260		468		5130
Printer #11		157		282		196		352		260		468		5130
Printer #12		157		282		196		352		260		468		5130
Printer #13		157		282		196		352		260		468		5130
Printer #14		157		282		196		352		260		468		5130
Printer #15		157		282		196		352		260		468		5130
Printer #16		157		282		196		352		260		468		5130
Printer #17		157		282		196		352		260		468		5130
Printer #18		157		282		196		352		260		468		5130
Subtotal	292	2828	523	5079	362	3530	643	6339	472	4682	843	8427	2250	92340
75 Baud Mode II														
Tributary #1	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Tributary #2	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Tributary #3	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Tributary #4	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Tributary #5	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Tributary #6	80	80	144	144	100	100	180	180	133	133	239	239	320	320
Subtotal	480	480	864	864	600	600	1080	1080	798	798	1434	1434	1920	1920
Tributary Total	15203	20903	27358	37607	18993	26118	34167	46989	25237	34714	45409	62474	144480	299460
Trib + ASC Total	27788	35117	50011	63191	34722	43884	62478	78966	46156	58342	83062	105002	206040	361020

Table 2-4. Most Severe (3 of 3)

1. 4800 Baud ASC circuits are from Scott.

2. 4800 Baud Tributaries are from Scott.

3. 2400 Baud KVDTs and printers are from Scott. The statistics represent an average of those listed in Scott's listing.

4. 1200 Baud SRTs are from Ramstein.

5. 1200 Baud KVDTs and printers are from Ramstein. The statistics represent an average of those listed in Ramstein's listing.

6. 75 Baud Mode II Tributaries are from Sembach. The statistics represent 25 precent of effective line capacity.

7. All statistics are listed in line blocks per hour as truncated integers.

To derive the Busy Hour subcolumn figures, three computational approaches, described as follows were evaluated.

1. A constructed approach based on experience with current service AMPEs, Automatic Digital Network I (AUTODIN I), and familiarity with data provided by the PMO.

$$\frac{\text{AHLB x HA x 75 PERCENT}}{\text{Weekly Busy Hours}} = \text{Busy Hour}$$

where AHLB = Average Hourly Line Blocks

HA = Hours Available in One Week (168)

75 Percent = 75 percent of the weekly message traffic is processed in five (Monday through Friday), 14 hour periods (usually 0900 to 2300 local hours).

Weekly Busy Hour = 70 (14 Daily Hours Times 5)

Example: AHLB = 29

HA = 168

Weekly Busy Hours = 70

Therefore:

$$\frac{29 \times 168 \times .75}{70} = 52.2$$

2. An approach based on an industrial telecommunications community practice for deriving Busy Hour where:

Busy Hour Line Block = (AHLB x 80%) + AHLB

Example: AHLB = 29

Therefore:

$$29 \times 1.8 = 52.2$$

3. An approach based on Defense Communication System, Traffic Engineering Practices (DCS - TEP) Volume XII, Sub Sec 502, Appendix H, November 1970, which defines Busy Period as follows:

Busy Period is equal to 2 busy hours; therefore, to find a busy hour the following must be applied:

$$\frac{\text{AHLB x 24 hours x 14.29\%}}{2} = \text{Busy Hour Line Blocks}$$

Example: $$\frac{29 \times 24 \times 14.29\%}{2} = 49.7 \text{ Busy Hour Line Blocks}$$

As shown, all three approaches result in a relativly close range. In view of the number of computations that were necessary, the 1.8 factor was applied to AHLB as a convenience to derive Busy Hour figures. CSC feels that the use of the formula giving the higher busy hour projection is sound and realistic in relationship to the continued growth of relative telecommunications.

2.2.2 Raw Data Plus 'J' Factor

The next column is identified as Raw Data Plus 'J' Factor. The "J" factor incorporates a management reserve into the final criteria to ensure that adequate processor capacity will be provided. This was computed by multiplying the Average Hour of the Raw Data field times 1.25 to give the Average Hour for the Raw Data Plus 'J' Factor field.

Example:

Raw Data				Raw Data and J Factor			
Avg Hour		Busy Hour		Avg Hour		Busy Hour	
Send	Rec	Send	Rec	Send	Rec	Send	Rec
4195	4738	7551	8528	5283	5922	9437	10659

times 1.8
times 1.8
times 1.25
times 1.25

Busy Hour was computed by multiplying the Average Hour by 1.8.

2.2.3 Raw Data Plus 'J' Factor Plus Growth

The third column is labeled Raw Data Plus 'J' Factor Plus Growth. The Growth factor allows for normal growth in traffic volume over the life span of the communications processor, usually considered to be 8 years, and was agreed upon during discussions with the PMO. The Average Hour of the Raw Data Plus

'J' Factor column was multiplied by 1.33 to arrive at the Average Hour for the Raw Data Plus 'J' Factor Plus Growth field.

Example:

Raw Data Plus J Factor				Raw Data Plus J Factor Plus Growth			
Avg Hour		Busy Hour		Avg Hour		Busy Hour	
Send	Rec	Send	Rec	Send	Rec	Send	Rec
5243	5922	9437	10659	6973	7876	12551	14176

times 1.8

times 1.33

times 1.8

times 1.33

Once again, Busy Hour was computed by multiplying Average Hour times 1.8.

2.2.4 Line Capacity

The fourth column is labeled Line Capacity. It represents the effective circuit throughput and is measured in line blocks per hour. It is computed by using the formula.

$$\frac{\text{Circuit baud rate x hourly seconds x 95 percent}}{\text{Line Blocks Bits}} = \text{Effective Line Capacity Line Blocks}$$

where:

Circuit Baud Rate = self explanatory (i.e., 1200 baud)

Line Block Bits = 800 (80 characters per line block times 10 bits per character)

NOTE: Line blocks as received at the processor from the Terminal Line Controller (TLC) do not have framing characters but do have character start and stop bits. Hence, we use 10-bit characters and 80-character line blocks.

Hourly Seconds = 3600 (60 x 60)

95% = Defense Communications Agency (DCA) Standard for circuit efficiency

Example: Circuit Baud Rate = 1200

Line Block Bits = 800

$$\frac{1200 \times 3600 \times .95}{800} = 5130 \quad \text{Line Blocks Per Hour}$$

Finally, allowances were made for circuit expansion to support new communications requirements. Circuit growth was established by incrementing the number of circuits in the following manner:

1. For 4800 Baud - increase by 15 percent or 1 circuit, whichever is greater
2. For 2400 Baud - increase by 25 percent or 2 circuts, whichever is greater
3. All others - increase by 33 percent or 3 circuits, whichever is greater.

2.3 SITE PERFORMANCE ANALYSIS

The site performance analyses are shown for Scott, Sembach, and Ramstein Air Force bases as Tables 2-1 through 2-3, respectively. The most severe requirements have been abstracted from each site analysis and consolidated into one report. These consolidated requirements are contained in Table 2-4. They will be used as the baseline criteria when formulating the test to determine performance capabilities of the AFAMPE. The use of this information is further discussed in Section 3, Test Methodology.

SECTION 3 - TEST METHODOLOGY

3.1 GENERAL

CSC recognizes the importance of establishing a sound methodology to ensure that the AFAMPE can meet current and future performance requirements. The approach to this critical process is discussed under the following headings:

1. Development of a Performance Test Plan (PTP)
2. Throughput Analysis
3. Performance Testing
4. Development of a Management Plan.

3.2 PERFORMANCE TEST PLAN (PTP)

CSC will produce a PTP that measures the AFAMPE system's capability to satisfy the performance requirements identified in Tables 2-1 through 2-4 and as further discussed in Paragraphs 3.3 (Throughput Analysis) and 3.4 (Performance Testing). Test scenarios will be designed to ensure that the same test, when applied multiple times, produces the same basic results. The PTP will:

1. Provide guidance for management and describe the technical effort necessary throughout the test period
2. Provide an orderly schedule of events, the methodology of testing, and a list of material to be delivered
3. Provide written requirements for the actual test inputs that exercise the system's capability at the different levels of throughput for the average hour, busy hour, and peak 10-minute intervals
4. CSC will develop recommended pass/fail criteria for each testing phase.

3.3 THROUGHPUT ANALYSIS

Throughput analysis deals with individual circuit types and measures the capacity of a particular circuit type without regard to other activity in the system. The results provide for absolute comparisons with, and measurements

of, degradation during later performance testing. For example, it is necessary to know how much traffic can be passed across the multiple AUTODIN circuits by the AFAMPE without competing activity. Throughput analysis will measure this activity. However, these same circuits will be sampled in the performance testing phase to ascertain throughput degradation. The unit of measure will be line blocks per hour (LBH). During individual circuit testing, acceptance is defined as the ability to pass traffic at 98 percent of the line capacity; e.g., 98 percent capacity for a 4800-baud circuit is 20744 LBH.

3.4 PERFORMANCE TESTING

The AFAMPE must be exercised under various loads to measure its capacity to handle average hour, busy hour, and peak 10-minute traffic loads. CSC will quantify the evaluation in addition to merely stating whether the system can or cannot meet the most severe criteria. To ensure this evaluation is realistic, the following items must be considered:

According to the documentation provided, the present AFAMPE testbed has access (for testing purposes) to the following:

1. Two - 4800-baud Mode I circuits into Tinker AUTODIN Switching Center (ASC)
2. One - World Wide Military Command and Control System (WWMCCS) terminal at Scott AFB (1 - 4800-baud REC and 1 - 4800 SEND circuits)
3. One - 2400-baud Mode I terminal (either a Standard Remote Terminal (SRT), Data Communication Terminal (DCT9000) or ~~UNIVAC (U418-3))~~
4. Two - Mode II 50-baud terminals
5. Two - Mode II 75-baud terminals.

NOTE: If both ASC circuits are active, the 2400-baud circuit cannot be active. Only two Mode I circuits can be active during a given period.

Patently, the present AFAMPE testbed cannot be exactly configured to duplicate any of the sites being modeled. The PMO has informed us that the following devices are or may be available during the test phase:

1. Two - Dynatest machines which can simulate Mode II interfaces

2. Possible use of a Perkin Elmer 7/32 as a software driver into the 3242.

Because additional simulation devices are unlikely, the performance tests will be structured carefully to utilize available devices to satisfy the test requirements.

It is highly unlikely 10 consecutive days of test time will be available at the Air Force Communications Computer Programming Center (AFCCPC) testbed due to scheduling conflicts. Accordingly, the test scenarios will be developed to allow a multiphased testing process that will be accomplished concurrently with the 3242 system development. The scheduling of these phases will be by mutual agreement of the PMO, CSC, and AFCCPC test facility. They are as follows:

1. PHASE I: AFCCPC personnel will exercise selected scenarios during different stages of system development. The results will be maintained for later analysis and verification.

2. PHASE II: Selected scenarios from previous tests will be exercised and matched against previous results to ensure test integrity. Once accomplished, additional scenarios will be applied to ensure individual site performance requirements as shown in Tables 2-1 through 2-3 are met. This testing will be performed by the test team in the presence of the Test Director and with CSC personnel assistance.

3. PHASE III: Once acceptable results have been obtained from the Phase II process, the AFAMPE will be tested to meet the performance requirements as shown in Table 2-4. This final set of scenarios, if successful, will provide a level of assurance for future growth of the AFAMPE not presently envisioned.

3.5 MANAGEMENT PLAN

CSC will develop a test management plan which will become part of the PTP. The management plan will include the following:

1. Test Schedule - A schedule of events associated with the PTP
2. Definition of Responsibility - The responsibilities of each organization participating in the test will be clearly defined
3. Controls - Procedures will be established which will allow the test team to exercise precise control over the test procedures and the authority to correct any identified discrepancies
4. Reporting Requirements - Required reports will be identified with responsible organization. Additionally, the required forms to support the entire test plan will be identified.

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